What is claimed is:

1. A copper alloy,

consisting essentially of Cu: 69 to 88 mass%, Si: 2 to 5 mass%, Zr: 0.0005 to 0.04 mass%, P: 0.01 to 0.25 mass%, and Zn: the balance;

having relation of, in terms of a content of an element a, [a] mass%, f0 = [Cu] - 3.5[Si] - 3[P] = 61 to 71, f1 = [P]/[Zr] = 0.7 to 200, f2 = [Si]/[Zr]=75 to 5000, and f3 = [Si]/[P] = 12 to 240;

forming a metal structure that contains α phase and, K phase and/or γ phase, and having relation of, in terms of a content of a phase b, [b]%, in an area rate, f4 = $[\alpha] + [\gamma] + [K] \geq 85$ and f5 = $[\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95; and

having an average grain diameter of 200 μm or less in a macrostructure when melted and solidified.

2. The copper alloy as claimed in claim 1,

additionally containing at least one selected from Pb: 0.005 to 0.45 mass%, Bi: 0.005 to 0.45 mass%, Se: 0.03 to 0.45 mass%, and Te: 0.01 to 0.45 mass%;

having relation of, in terms of the content of the element a, [a] mass%, f0 = [Cu] - 3.5[Si] - 3[P] + 0.5([Pb] + 0.8([Bi] + [Se]) + 0.6[Te]) = 61 to 71, f1 = [P]/[Zr] = 0.7 to 200, f2 = [Si]/[Zr] = 75 to 5000, f3 = [Si]/[P] = 12 to 240, f6 = $[Cu] - 3.5[Si] - 3[P] + 3([Pb] + 0.8([Bi] + [Se]) + 0.6[Te])^{1/2} \geq 62$, and f7 = $[Cu] - 3.5[Si] - 3[P] - 3([Pb] + 0.8([Bi] + [Se]) + 0.6[Te])^{1/2} \leq 68.5$ ([a] = 0 as to a non-contained element a);

forming the metal structure that contains α phase and, K phase and/or γ phase, and having relation of, in terms of the content of the phase b, [b]%, in an area rate, f4 = $[\alpha] + [\gamma] + [K] \geq 85$ and f5 = $[\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95 ([b] = 0 as to a non-

contained phase b); and

having an average grain diameter of 200 μm or less in a macrostructure when melted and solidified.

3. The copper alloy as claimed in claim 1,

additionally containing at least one selected from Sn: 0.05 to 1.5 mass%, As: 0.02 to 0.25 mass% and Sb: 0.02 to 0.25 mass%;

having relation of, in terms of the content of the element a, [a] mass%, f0 = [Cu] - 3.5[Si] - 3[P] - 0.5([Sn] + [As] + [Sb]) = 61 to 71, f1 = [P]/[Zr] = 0.7 to 200, f2 = [Si]/[Zr] = 75 to 5000, and f3 = [Si]/[P] = 12 to 240 ([a] = 0 as to a non-contained element a);

forming the metal structure that contains α phase and, K phase and/or γ phase, and having relation of, in terms of the content of the phase b, [b]%, in an area rate, f4 = $[\alpha] + [\gamma] + [K] \geq 85$ and f5 = $[\gamma] + [K] + 0.3[\mu] - [\beta]$=5 to 95 ([b]=0 as to a non-contained phase b); and

having an average grain diameter of 200 μm or less in a macrostructure when melted and solidified.

4. The copper alloy as claimed in claim 2,

additionally containing at least one selected from Sn: 0.05 to 1.5 mass%, As: 0.02 to 0.25 mass% and Sb: 0.02 to 0.25 mass%;

having relation of, in terms of the content of the element a, [a] mass%, f0 = [Cu] - 3.5[Si] - 3[P] + 0.5([Pb] + 0.8([Bi] + [Se]) + 0.6[Te]) - 0.5([Sn] + [As] + [Sb]) = 61 to 71, f1 = [P]/[Zr] = 0.7 to 200, f2 = [Si]/[Zr] = 75 to 5000, f3 = [Si]/[P] = 12 to

240, $f6 = [Cu] - 3.5[Si] - 3[P] + 3([Pb] + 0.8([Bi] + [Se]) + 0.6[Te])^{1/2} \geq 62$, and $f7 = [Cu] - 3.5[Si] - 3[P] - 3([Pb] + 0.8([Bi] + [Se]) + 0.6[Te])^{1/2} \leq 68.5$ ([a] = 0 as to the non-contained element a);

forming the metal structure that contains α phase and, K phase and/or γ phase, and having relation of, in terms of the content of the phase b, [b]%, in an area rate, $f4 = [\alpha] + [\gamma] + [K] \geq 85$ and $f5 = [\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95 ([b] = 0 as to the non-contained phase b); and

having an average grain diameter of 200 μm or less in a macrostructure when melted and solidified.

5. The copper alloy as claimed in any one of claims 1 to 4,

additionally containing at least one selected from Al : 0.02 to 1.5 mass%, Mn : 0.2 to 4 mass%, and Mg : 0.001 to 0.2 mass%;

having relation of, in terms of the content of the element a, [a] mass%, $f0 = [Cu] - 3.5[Si] - 3[P] + 0.5([Pb] + 0.8([Bi] + [Se]) + 0.6[Te]) - 0.5([Sn] + [As] + [Sb]) - 1.8[Al] + 2[Mn] + [Mg] = 61$ to 71, $f1 = [P]/[Zr] = 0.7$ to 200, $f2 = [Si]/[Zr] = 75$ to 5000, and $f3 = [Si]/[P] = 12$ to 240 ([a] = 0 as to the non-contained element a);

forming the metal structure that contains α phase and, K phase and/or γ phase, and having relation of, in terms of the content of the phase b, [b]%, in an area rate, $f4 = [\alpha] + [\gamma] + [K] \geq 85$ and $f5 = [\gamma] + [K] + 0.3[\mu] - [\beta] = 5$ to 95 ([b] = 0 as to the non-contained phase b); and

having an average grain diameter of 200 μm or less in a macrostructure when melted and solidified.

6. The copper alloy as claimed in any one of claims 2, 4 and 5,

having relation of, between the content of the element a, [a] mass%, and the content of the phase b, [b]%, in an area rate, $f8 = [\gamma] + [K] + 0.3[\mu] - [\beta] + 25([Pb] + 0.8([Bi] + [Se]) + 0.6[Te])^{1/2} \geq 10$, and $f9 = [\gamma] + [K] + 0.3[\mu] - [\beta] - 25([Pb] + 0.8([Bi] + [Se]) + 0.6[Te])^{1/2} \leq 70$ ([a] = [b] = 0 as to the non-contained element a and phase b).

7. The copper alloy as claimed in any one of claims 1 to 6,

wherein, when any one of Fe and Ni is contained as an inevitable impurity, a content of any one of Fe and Ni is less than 0.3 mass%; and when Fe and Ni are contained as an inevitable impurity, a total content of Fe and Ni is less than 0.35 mass%.

8. The copper alloy as claimed in any one of claims 1 to 7,

wherein, when melted and solidified, a primary crystal is the α phase.

9. The copper alloy as claimed in any one of claims 1 to 7,

wherein, when melted and solidified, a peritectic reaction is generated.

10. The copper alloy as claimed in any one of claims 1 to 7,

wherein, when melted and solidified, a dendrite network has a divided crystalline structure, and a two-dimensional shape of a grain has any one of a circular shape, a non-circular shape near to the circular shape, an elliptical shape, a criss-cross shape, an acicular shape and a polygonal shape.

11. The copper alloy as claimed in any one of claims 1 to 7,

wherein, the α phase of a matrix is finely divided, and at least one of the K and γ phases are uniformly distributed in the matrix.

12. The copper alloy as claimed in any one of claims 2, 4, 5 and 7,

wherein, when any one of Pb and Bi is contained, any one of Pb and Bi particles having a fine uniform size is uniformly distributed in a matrix.

13. The copper alloy as claimed in any one of claims 1 to 12, having any one of a casting obtained in a casting process and a plastic worked material additionally performing plastic working on the casting at least once.

14. The copper alloy as claimed in claim 13,

wherein, when the plastic worked material is cut by a lathe using a bite of a rake angle: -6° and a nose radius : 0.4 mm under a condition of a cutting speed : 80 to 160 m/min, a cutting depth : 1.5 mm and a feed speed : 0.11 mm/rev., a generated cut chip is a cut worked material taking a small segment shape of a trapezoidal or triangular shape, and a tape or acicular shape having a length of 25 mm or less.

15. The copper alloy as claimed in claim 13,

wherein, the casting is a wire, a rod, or a hollow bar cast by horizontal continuous casting, upward casting or up-casting.

16. The copper alloy as claimed in claim 13,

wherein, the plastic worked material is a hot extruded material, a hot forged material or a hot rolled material.

17. The copper alloy as claimed in claim 13,

wherein, the plastic worked material is a wire, a rod, or a hollow bar formed by stretching or cold drawing the casting defined in claim 15.

18. The copper alloy as claimed in claim 13,

wherein, the casting is a casting, a semi-melted casting, a semi-melted formed material, a molten metal forged material or a die cast formed material where at least dendrite network has the divided crystalline structure in a semi-melted state of a solid phase fraction of 30 to 80% and the two dimensional shape of the solid phase has any one of the circular shape, the non-circular shape near to the circular shape, the elliptical shape, the criss-cross shape, the acicular shape and the polygonal shape.

19. The copper alloy as claimed in claim 18,

wherein, in the solid phase fraction of 60%, an average grain diameter of the solid phase is less than 150 μm and/or an average maximum length of the corresponding solid phase is less than 200 μm.

20. The copper alloy as claimed in claim 18 or 19,

wherein, the copper alloy is cast to a near net shape.

21. The copper alloy as claimed in any one of claims 13 to 20,

wherein, the copper alloy is a water-contact fitting used in contact with water at all times or temporally.

22. The copper alloy as claimed in claim 21,

wherein the copper alloy is a nipple, a hose nipple, a socket, an elbow, a cheese, a plug, a bushing, a union, a joint, a flange, a stop valve, a strainer, a slith valve, a gate valve, a check valve, a glove value, a diaphragm valve, a pinch valve, a ball valve, a needle valve, a miniature valve, a relief valve, a plug cock, a handle cock, a gland cock, a two-way cock, a three-way cock, a four-way cock, a gas cock, a ball valve, a safety valve, a relief valve, a pressure reducing valve, an electromagnetic valve, a steam trap, a tap water meter, a flowmeter, a hydrant, a water sprinkling faucet, a water stop faucet, a swing cock, a mixed faucet, a corporation faucet, a spout, a branch faucet, a check valve, a branch valve, a flash valve, a switch cock, a shower, a shower hook, a plug, a zarubo, a watering nozzle, a sprinkler, a heating pipe for a water heater, a heating pipe for a heat exchanger, a heating pipe for a boiler, a trap, a fireplug valve, a water supply port, an impeller, an impeller shaft or a pump case or their constituent member.

23. The copper alloy as claimed in any one of claims 13 to 20,

wherein, the copper alloy is a frictional engagement member performing relative movement in contact with water at all times or temporally.

24. The copper alloy as claimed in claim 23,

wherein, the copper alloy is a gear, a sliding bush, a cylinder, a piston shoe, a bearing, a bearing part, a bearing member, a shaft, a roller, a rotary joint part, a bolt, a nut, or a screw shaft, or their constituent member.

25. The copper alloy as claimed in any one of claims 13 to 20,

wherein, the copper alloy is a pressure sensor, a temperature sensor, a connector, a compressor part, a scroll compressor part, a high pressure valve, a valve open-close value for an air conditioner, a carburetor part, a cable fixture, a mobile phone antenna part, or a terminal.

26. A method of producing a copper alloy as claimed in any one of claims 1 to 25,

wherein, in a casting process, Zr is added in a form of a copper alloy material containing Zr, and Zr is prevented from being added in a form of an oxide and/or sulfide when casting.

27. The method as claimed in claim 26,

wherein, the copper alloy material containing Zr is a copper alloy that additionally contains at least one selected from P, Mg, Al, Sn, Mn and B based on a Cu-Zr alloy, a Cu-Zn-Zr alloy or their alloy.